

NOTE TO SPECIFIER: Use Conc. 3C in conjunction with Conc. 3 if there will be severe sulfate attack. (See Concrete Manual - table 2.)

b. Cementitious material options. - Cementitious materials shall be furnished in accordance with one of the following options:

- (1) Type V portland cement only.
- (2) Type V portland cement plus a class N, F, or C pozzolan.
- (3) Type II portland cement plus a class N, F, or C pozzolan.
- (4) Type IP(MS) blended hydraulic cement only.

c. Materials. -

(1) Portland cement. - Portland cement shall meet the requirements of ASTM designation: C 150 for type II or V cement, dependent on the cementitious materials option chosen, and shall meet the optional false-set limitation specified therein. Portland cement shall also conform to the low-alkali limitation unless the Contractor selects aggregates which are not potentially alkali reactive.

(2) Pozzolan. - Pozzolan used under the options specified in subparagraphs b.(2), (3), and (4) above shall meet the requirements of ASTM designation: C 618 for class N, F, or C with the following additional requirements:

(a) The maximum percent of sulfur trioxide shall be 4.0 percent for classes F and C.

(b) The maximum percent loss on ignition shall be 8.0 percent for class N and 2.5 percent for classes F and C.

(c) The pozzolanic activity index with lime shall be determined using 2-inch cubes, and the minimum strength at 7 days shall be 900 pounds per square inch.

(d) Unless the Contractor selects aggregates which are not potentially alkali reactive as stated below, pozzolan used under the options specified in subparagraphs b.(2) and (3) above shall be tested for reduction of mortar expansion at 14 days as specified for class N pozzolan under the optional physical requirements in table 2A of ASTM designation: C 618. However, the cement used in the test shall be low alkali. For the pozzolan to be acceptable, it shall result in an expansion reduction of zero percent or greater when compared to the control test.

Furthermore, pozzolan used under the options specified in subparagraphs b.(3) and (4) above shall significantly increase the sulfate resistance of concrete; and pozzolan used under the option specified in subparagraph b.(2) above shall not decrease the sulfate

resistance of concrete. The following class N pozzolans have been found to significantly increase sulfate resistance, and either of them may be used under the option specified in subparagraphs b.(2), (3), and (4) above:

- (a) "Lassenite SR" pozzolan, as marketed by Lassenite Industries, Inc., 1475 Terminal Way, Reno NV 89502, from plant located near Herlong, California.
- (b) "Sun" pozzolan, as produced by Oregon Portland Cement Co., 111 SE. Madison, Portland OR 97214, from plant located near Lime, Oregon.

Bureau of Reclamation research on class F and C pozzolans has correlated sulfate resistance to a resistance factor "R." "R" is defined as  $(C-5)/F$  where "C" is the calcium oxide content of the pozzolan in percent and "F" is the ferric oxide content in percent. The higher the "R" factor, the lower the sulfate resistance expected for concrete containing the pozzolan. The "R" factor of class F or C pozzolan shall be less than 2.5 when used with type V cement or when used in blended cement containing clinker with not more than 5.0 percent  $C_3A$ . The "R" value of class F or C pozzolan shall be less than 1.5 when used with type II cement or when used in type IP(MS) blended cement. Calcium and ferric oxide contents shall be determined in accordance with ASTM designation: C 114.

(3) Blended cement. - Blended cement shall meet the requirements of ASTM designation: C 595 for type IP(MS) portland pozzolan cement and shall meet the following constraints:

- (a) The optional false-set limitation specified in ASTM designation: C 150.
- (b) The physical requirement of ASTM designation: C 595 for mortar expansion of type P cement at 14 days, unless the Contractor selects aggregates which are not potentially alkali reactive as stated below.
- (c) The pozzolan constituent shall be between 15 and 25 weight percent of the portland pozzolan cement.
- (d) The amount of pozzolan in the finished cement shall not vary by more than plus or minus 3 weight percent of the finished cement from that stated by the Contractor in the information submitted to the Contracting Officer as required below.
- (e) Pozzolan used in blended cement shall meet the applicable requirements in subparagraph c.(2) above.

The low-alkali limitation for portland cement and the mortar expansion requirement for pozzolan and blended cement may be waived if the Contractor selects concrete aggregate sources which have previously been tested by the Bureau of Reclamation and which, as evidenced by petrographic examination or mortar bar tests, or both, do not contain

potentially deleterious amounts of particles which may react with alkalis in cementitious materials. If available, information regarding the potential alkali reactivity of aggregate from a particular source may be obtained from the <sup>1</sup>[(Project) Construction Engineer, \_\_\_\_\_].] If the potential alkali reactivity of an aggregate source is unknown, the low-alkali limitation and mortar expansion requirements shall be met.

At least 30 days before first shipments of any cementitious materials <sup>2</sup>(including cementitious materials for use in shotcrete, soil-cement, grout, and precast concrete items such as pipe, beams, and tees,) the Contractor shall inform the Contracting Officer, in writing, of the following:

The names and addresses of cement and pozzolan shipping points

The names and addresses of cement and pozzolan suppliers from which the Contractor will purchase cementitious materials

The names and addresses of contractors to whom cement and pozzolan will be shipped if other than the prime Contractor

The quantities of cement and pozzolan ordered

Whether cement will be ordered in bulk or in bags

The purchase order number, contract number, or other designation that will identify cement and pozzolan to be used by the Contractor.

The source and composition of the constituents in blended cement

The weight percent of the pozzolan constituent in blended cement

The Contractor shall not change the cementitious materials option selected, or sources of cement and pozzolan for providing cementitious materials under the option, without the written approval of the Contracting Officer.

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<sup>1</sup>Insert address of field office concerned.

<sup>2</sup>Delete or revise as required.